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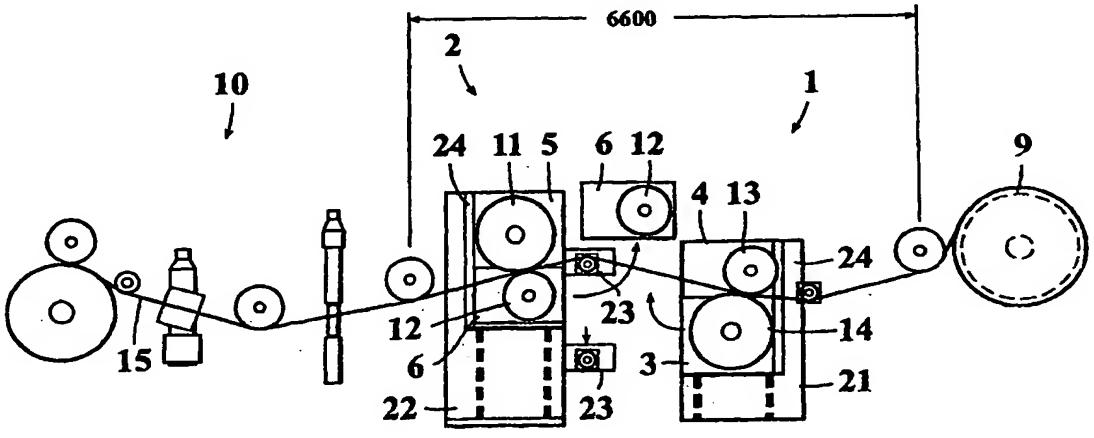
(54) Title: CALENDER AND AN ARRANGEMENT FOR FASTENING ROLLS OF A CALENDER



(57) Abstract: A calender and an arrangement for mounting calender rolls, the calender comprising at least two calender nips (1, 2) formed by at least two stacked rolls (11 - 14). The rolls have bearing housings (3 - 6) by means of which the rolls (11 - 14) are stacked into roll pairs forming the calender nips (1, 2), and means (31, 32) connecting the bearing housings (3, 4 and 4, 5) of the rolls pairs with each other. At least two successive calender nips (1, 2) are arranged so that in the successive nips the mutual distance between the longitudinal axes of the lower rolls (12, 14) is smaller than the corresponding mutual distance between the respective upper rolls (11, 13) of the nips, whereby the disposition of the rolls (11 - 14) forms a V-shaped angle as seen from the end of the calender machinery and thus forms an operating area between the nips for changing the rolls. The rolls are combined into nips advantageously using heatable pull rods inserted through the bearing housings.

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CALENDER AND AN ARRANGEMENT FOR FASTENING ROLLS OF A CALENDER

The present invention relates to a calender according to the preamble of claim 1 for surface-treating a moving web of paper or board.

The invention also relates to a construction suited for mutual mounting of calender rolls.

Different types of calenders are used for improving the smoothness and surface profile of manufactured sheet of paper or board. One of the concurrent calender types is the soft-nip calender comprising at least two calender nips operating in succession along the sheet travel, whereby each nip is formed by a soft roll and a hard roll mounted to rotate on each other. Today, the soft roll is generally surfaced with a polymer coating, while the hard roll is a heatable roll made from cast iron. The different types of rolls are mounted as an alternating succession in a vertical stack thus forming successive nips, whereby either side of a running web travels alternately over a soft roll, a hard roll and so on, thus making both sides of the sheet maximally equal after the surface-treatment. The calender rolls, particularly the soft roll, undergo wear during the use, thereby invoking a need of scheduled replacement. Today, two different techniques of roll replacement are used. In one arrangement, the old roll with its bearing housings is elevated away from its operating position by means of an overhead hoist. Herein, either the upper roll must always be removed before the lower roll can be replaced or,

alternatively, the roll stacks must be askewed from a vertical plane in order to facilitate a sideways obliquely performed lifting of the lower roll away from its normal position under the upper roll. Also in vertically aligned roll stacks it is possible to implement the removal of the lower roll to take place in a sideways direction by first shifting the lower roll laterally away from under the upper roll. In this type of a construction, the frame of the calender stack must be open at least in the direction of the lower roll removal.

When the construction is such as to allow the lower roll to be removed only after the removal of the upper roll, the roll replacement operation becomes extremely clumsy, particularly if the upper roll is a heatable roll, as is the case inevitably always for the second nip, because the roll connections such as those of the heating medium circulation must be disconnected during the removal of the roll. In a roll replacement system with a sideways shifting arrangement of the rolls, sufficient free space must be reserved for the movement of either roll. Such servicing space for roll replacement requires more footprint about the calender. As the roll diameters in modern papermaking machines are large, the headroom for roll replacement may be as large as two meters per roll and, since a calender always has at least two calender nips, the need of lateral footprint may be up to four meters for a two-nip calender. Obviously, this kind of roll mounting is not possible in such machinery rebuild operations wherein a soft-nip calender must be fitted to replace an outdated machine calender. During machinery rebuild, it may be necessary to relocate various units of

the papermaking machinery and increase the length of the machine, which is expensive. Also in new factory projects, a machine of a larger overall length increases costs due to larger footprint, among other factors. Another drawback of a large lateral roll change space is that the web must travel as open draw over the roll change space, because this portion of machinery cannot be equipped with auxiliary devices. Long, open web draws increase the risk of web breaks and complicate web tail threading.

It is also possible to replace the lower roll of a calender nip by way of elevating the upper roll apart from the lower roll and then moving the lower roll with its bearing housings aside supported by a roll transfer carriage, whereupon the roll can be replaced. This arrangement is hampered by the large lateral space required about the roll and its need for a dual set of roll handling equipment, whereby the lift must be complemented with at least two transfer carriages, which makes this construction costly.

Attempts have been made to reduce the space requirement of the calender in the machine direction of the web travel by way of, e.g., locating the calender frames of two successive roll nips, the frames having one open side, in a back-to-back disposition of the frames by their closed sides, whereby the web travel between the successive nips is maximally minimized. While this arrangement needs a smaller layout footprint, a problem arises from the roll replacement operations that now must be performed on opposite sides of the calender frame thus

still needing as much roll change headroom as in any other conventional calender.

It is an object of the present invention to provide an entirely novel type of calender construction capable of overcoming the problems of the prior art techniques described above.

The goal of the invention is achieved by way of disposing two successive calender nips so that the mutual distance between the lower rolls of the successive nips is smaller than the mutual distance between the upper rolls of the nips, whereby the rolls of the nips as seen from their ends are disposed in a V-shaped configuration.

Herein, the calender rolls can be connected to each other by means of pull rods adapted to connect the roll bearing housings to each other, whereby the connections to the auxiliary devices of the roll may be adapted into the roll stack so as form an integrated auxiliary equipment assembly.

More specifically, the calender according to the invention is characterized by what is stated in the characterizing part of claim 1.

The invention offers significant benefits.

By virtue of the invention, it is possible to gain a substantial reduction in the footprint occupied in the machine direction by a calender such as a soft-nip calender or the like comprising a plurality of separate roll nips.

The invention also facilitates a simple replacement of the lower rolls. The calender framework becomes extremely uncomplicated and lightweight, because the roll bearing housings are connected to each other so that the nip forces are not transmitted to the framework. Now, since the calender framework is relieved from high forces imposed thereon by the roll nips, also the calender foundations are not subjected to high stresses. Hence, a calender according to the invention is aptly suited for machine rebuilds intended, e.g., to improve the quality of the manufactured product with the help of a more efficient calender. A calender according to the invention may even be fitted to replace a single-stack machine calender in places where prior-art calender constructions could not necessarily be squeezed onto the footprint left free by a dismantled two-stack machine calender. Furthermore, the length of open web draws remains short and the number of guide rolls is smaller than in conventional calender constructions. The bearing housings of any roll pair forming a nip are connected to each other by techniques that in an uncomplicated and precise manner give the required roll fixing force also for the upper rolls, and there are provided transfer and support means for the auxiliary devices operating between the calender nips so as to permit the displacement of these devices for the time the lower rolls are being replaced. The fluid, electrical and other connections of the rolls and their auxiliary means are concentrated at the roll ends and enclosed therein, whereby the connections have enough headroom so that there is no need to disconnect them from the rolls being replaced. It is even possible to design the entire calender into an integrated unit that can be

shipped to a customer and rapidly mounted on site as a replacement of an existing calender or as a part of new machinery being erected.

In the following, the invention will be examined with the help of exemplifying embodiments and by making reference to the appended drawings in which

FIG. 1 shows a conventional calender construction;

FIG. 2 shows another conventional calender construction;

FIG. 3 shows a third conventional calender construction;

FIG. 4 shows schematically an embodiment of the calender construction according to the invention;

FIG. 5 shows schematically the roll replacement operation in the calender embodiment of FIG. 4;

FIG. 6 shows schematically the roll replacement operation in the calender embodiment of FIG. 4 when the lower roll is already removed;

FIG. 7 shows in a side view one mounting technique of calender bearing housings;

FIG. 8 shows in a top view the arrangement of FIG. 7; and

FIG. 9 shows another mounting technique of calender bearing housings.

Referring to FIG. 1, the calender construction shown therein has bearing housings 3 - 6 of rolls 11 - 14 connected to each other and the roll nips 1 and 2 have separate frames. A web 15 enters a first roll nip, e.g., from an unwinder 9 and then travels from first a nip 1 to a second nip 2 over a guide/spreading roll 8. Next downstream from the calender is located a set of measurement equipment 10 and guide rolls that pass the web 15 to the subsequent treatment stage such as a winder. Under each one of the bearing housings 3, 6 of the lower roll 12, 14 of either roll nip 1, 2 is disposed a roll change carriage 7, and the roll change is performed by way of first detaching the bearing housings 3, 4 and 5, 6, respectively, from each other, then elevating the upper bearing housing upward and lowering the lower bearing housing onto the roll change carriage 7 and subsequently moving the same clear from below the upper roll, thus allowing the roll to be changed at the side of the calender. In this exemplifying case, the machine-direction length of the calender is 8300 mm, which can hardly be made shorter, because guide or spreading rolls are necessarily needed between the calender nips 1, 2, as well as in front of them and after them.

In the embodiment of FIG. 2, C-shaped frames 16, 17 of the calender nips 1, 2, respectively, are disposed back-to-back, and the bearing housings 3, 6 of the lower rolls 12, 14, respectively, are mounted supported on hydraulic cylinders 18, thus allowing the housings during the roll change operation to be lowered downward and then moved out of way past the frames 16, 17. Inasmuch the rolls 12, 14 may have a very large diameter, the operating space on

both sides of the frame must be made wide, up to 2 m, in order to perform an unobstructed lift of the calender rolls. Not even this arrangement can make the calender machine-direction length shorter than the referenced dimension of 8400 mm. Furthermore, the nip forces are imposed on the open frame of the roll nips that accordingly must be made very rigid and massive.

In the embodiment of FIG. 3, the frames 19, 20 are oriented in the same direction. This arrangement is the most wasteful in terms of footprint usage and, consequently, in many cases the most expensive to implement giving a reference dimension of 9700 mm for the length of this type of calender that, as is evident from the diagram, can hardly be made shorter. It must be noted herein that, since the reference dimensions given above represent those of the exemplifying embodiments, actually required operating space is ultimately determined by the basic dimensions of the machinery such as roll diameters.

In FIG. 4 is shown a schematic view of an embodiment according to the invention. In this construction, the bearing housings 3 - 6 of the calender rolls 11 - 14 are mounted on lightweight frames 21, 22. Additionally, the bearing housings 3 - 6 are connected to each other so that the nip forces are not transmitted to the frames 21, 22 of the calender nips 1, 2. The rolls 11, 12 and 13, 14 of either calender nip 1, 2, respectively, are arranged in a mutually laterally displaced position so that the longitudinal axes of the stacked rolls are not located in the same vertical plane. The calender frames 21, 22 are adapted in a facing disposition so that the mutual dis-

tance between the longitudinal axes of the lower rolls of the roll nips is smaller than the corresponding mutual distance between the upper rolls of the nips, whereby the disposition of the rolls form a V-shaped angle as seen from the end of the calender machinery. This disposition allows the operating area for changing the lower rolls to be adapted between the opposed calender nips 1, 2 thus disposing with the need for two separate roll change areas. In the illustrated exemplifying embodiment, each calender nip comprises a soft roll 11, 14 and a heatable hard roll 12, 13 that forms a nip with its respective soft roll.

For changing the rolls, the calender according to the invention is complemented with some auxiliary means. The bearing housings 4, 5 of the upper rolls 11, 13 are mounted on guides 24 which are fixed to the frames 21 and 22 and along which the bearing housings can be slidably elevated upward away from their superimposed location above the bearing housings 3, 6 of the lower rolls 12, 14. Obviously, the guides 24 may be replaced by any other similar guidance means. The intervening units between the calender nips, such as rolls, a steam box, measurement equipment or other possible auxiliary devices can be advantageously combined into an integrated assembly 23 that is mounted to the upper roll bearing housing 5 by aligning the assembly with a keyed connection and then fixing it in place by means of bolts. Alternatively, the assembly with its auxiliary devices can be mounted on the lower roll bearing housing. In the exemplifying embodiment shown in FIGS. 4 and 5, the assembly includes only one roll. Obviously, the assembly can be integrated to

include any necessary auxiliary devices with their electrical, fluid and compressed-air connections so dimensioned that the assembly can be lowered below the lower rolls, between the calender nips, for the duration of a roll change. The integrated auxiliary equipment assembly 23 can be lowered to rest on fixing means adapted to the calender frame 22 as shown in FIG. 4 or, alternatively, onto the floor as shown in FIG. 5.

In this calender embodiment, the change of the upper rolls 11, 13 can be made simply by using a lift for elevating the roll away from its operating position above the lower roll bearing housing. The lower rolls 12, 14 are changed by way of disconnecting the bearing housings from each other and then lifting the upper rolls 11, 13 upward along the guides 24. Next, the bearing housings 3, 6 of the lower rolls 12, 14 are detached from the frames 21, 22, whereupon the rolls can be transferred by a lift away from the lift area remaining between the calender nips 1, 2. Prior to the lifting of the lower rolls and, advantageously, before the bearing housings are detached, the auxiliary equipment assembly 23 is detached and lowered down to keep it clear from the transfer path of the lower rolls. Obviously, the installation of a new roll takes place in a reverse order. To assure fast roll replacement, it is essential to have the connections of the upper rolls 11, 13 and the auxiliary equipment assembly 23 implemented with such dimensioning rules that these units need not be dismantled when these units must be moved aside.

In FIG. 6 are shown the details related to the roll

change operation and the construction of the calender frame and its bearing housings. Herein, the frame 22 has a box-section structure in which the waist plates of the frame form a U-section in which the sides act as guide surfaces 24 for the movement of the upper bearing housing 5. In the diagram, the upper bearing housing 5 is shown elevated into its upper position for the duration of the roll change. The bearing housing 5 is supported to the frame 22 by means of a pin 36 fitted into a hole made to the frame.

The lower roll is replaced as follows. First, the auxiliary equipment assembly 23 situated in front of the nip is detached from the bearing housings 5, 6 and is lowered below the lower roll without any need to dismantle its connections, whereupon the bearing housings 5, 6 can be disconnected from each other. The upper roll is elevated upward under the guidance provided by the guide surfaces 24 formed on the frame 22 and is locked in place by way of, e.g., pushing a pin 36 either manually or by actuator means through the holes made to the upper part of the frame 22 and the upper part of the bearing housing 5. Resultingly, the upper roll remains resting on the pin supported by the bearing housing 5 so that the lower edge of the bearing housing 5 leans against the frame 22. The connections of the upper roll must be designed such that they permit lifting the roll into its locked position during roll change without any need for dismantling the connections. Hereafter, the lower roll bearing housings 6, as well as the connections of the roll and the mechanical drive shaft thereof, are detached from the frame 22. If there are any auxiliary devices located in front

of the lower roll, such as a cleaning doctor, the auxiliary devices are rotated aside clear of the roll change transfer path either manually or using powered actuators. Subsequently, the lower roll with its bearing housings 6 can be elevated away from the area remaining between the roll nips. Obviously, the installation of a new roll takes place in a reverse order.

As mentioned earlier, the present invention relates to calender constructions in which the bearing housings of the calender rolls are connected to each other. The required nip force as well as the opening and closing of the nip are implemented by means of a mechanism acting on a deflection-compensated roll, whereby the calender frame receives only a minimal portion of the reactive forces resulting from the actuation of the nip pressure. To achieve a fast and reliable roll change and, above all, easy installation of a new roll, the connection of bearing housings to each other must be designed uncomplicated and such that gives a sufficiently large and very accurately correct nip force. Obviously, the embodiment must also assure an accurate alignment of the bearing housings.

In FIG. 6 is shown one method for a reliable connection of the bearing housings 3, 4 to each other. In this embodiment, the bearing housings are provided with planar or wedge-shaped clamping surfaces 27, whereby the bearing housings can be clamped together against each other by means of clamp members 25 that are in a compatible manner provided with wedge-shaped or planar surfaces 28. The clamp members are C-shaped and have their clamping

surfaces on the inner sides of the shaped member. The wedged contact between the clamping surfaces 27 of the clamp member and the respective projections of the bearing housings can be implemented by way of using a wedged shape on both or only one of the opposed clamping surfaces. The clamp members 25 are made so wide as to extend over the entire width of the bearing housings, whereby they are pressed against the sides of the bearing housings by means of tensioning bolts 26 that connect the clamp members located on the opposite sides of the bearing housings to each other and thus press the clamp members 25 against the side surfaces 27 of the clamping projections of the bearing housings. In the illustrated embodiment, the tensioning bolts 26 are disposed at the sides of the bearing housings and to ease their insertion, the upper bearing housing 4 is provided with bolt support guides 29 through which the bolts are passed. When the tensioning bolts are tightened with a given torque, the bearing housings are compressed against each other at a given force. This mounting method is fast and reliable, yet needing less space in the machine direction than a conventional mounting technique using bolts. The illustrated mounting method permits an extremely rapid roll replacement in the calender according to the invention and, hence, this mounting arrangement is also advantageously used for connecting the lower bearing housing 3 to the calender frame.

In FIG. 8 is shown an alternative method of mounting the bearing housings 3, 4. Herein, into mounting holes 35 drilled to the bearing housings 3, 4 are inserted pull rods 30, each of them having an electrical heater element

34 adapted into its center bore. The lower end of the pull rod has a collar projection 31 adapted to rest against the edge of the mounting hole 35 drilled to the lower bearing housing 3. The upper end of the pull rod 30 has an annular recess 33 capable of accommodating a locking piece 32 that rests against the edge of the mounting hole 35 drilled to the upper bearing housing 4. Obviously, the pull rod 30 may also be inserted into an inverted position. Now, the mounting of the bearing housings takes place by way of inserting the pull rods 30, after they are heated with the help of the heater elements 34, into the mounting holes 35 drilled to the superimposed bearing housings 3, 4, whereby the distance from the proximal edge of the collar projection 31 to the distal edge of the annular recess 33 is thermally extended so much that the locking piece can be inserted between the edge of the mounting hole 35 drilled to the upper bearing housing 4 and the distal edge of the annular recess 33. In other words, the distance from the proximal edge of the locking piece to the proximal edge of the pull rod collar projection at the beginning of the mounting operation is kept larger than the distance between the outer surfaces of the mounting holes 35 drilled to the bearing housings 3, 4. The locking piece 32 may be, e.g., a split ring that is joined with bolts or as well any other conventional locking member. After the locking piece 32 is firmly mounted in the annular recess 33, the heater element 34 is deenergized or pulled out from the pull rod center bore, whereupon the rod begins to contract thus pulling the bearing housings against each other. At the ambient temperature of the calender, the target length of the contracted pull rod

defined as the distance between the proximal edges of its locking parts must be shorter than the distance between the outer edge surfaces of the mounting holes drilled to accommodate the pull rods. Under very warm conditions, the ambient temperature may rise as high as 40 to 50 °C, while in the machinery halls of cold-climate factories the ambient temperature can be very close to 0 °C. Generally, the operating ambient temperature is in the order of 10 - 30 °C.

The connecting force imposed by the pull rods is easy to control to a desired value inasmuch the force generated by a contracting rod can be readily computed. The pull rod is advantageously made from steel whose thermal expansion coefficient is known precisely. Obviously, the rod may be made from any other material of a sufficiently high strength, whereby the above-mentioned locking members 31, 32, 33 can be replaced by nuts having a thread compatible with those made to the rod ends or, alternatively, other locking means can be used capable of accurately positioning the rod in its longitudinal axis direction. Instead of using a heater element, the rod may be heated by other methods such as an oven or a heating bath, but this technique requires a rapid installation sequence during which the rod may not cool down. The electrical heater element can be mounted in a permanent or removable manner.

In addition to the exemplifying embodiments described above, different modifications may be contemplated without departing from the spirit of the invention.

While only a soft-nip calender is discussed above as an example of calender types, the invention can as well be applied to all such calenders that include at least two calender nips formed by two rolls. The angle between the inclined roll stacks, that is, the V-angled disposition between the adjacent roll stacks can be varied, however, not making the angle smaller that what is necessary to ensure unobstructed removal of the lower roll from below the upper roll. The required tilt angle between the rolls stacks is determined by such factors as the outer dimensions of the rolls and their bearing housings. Typically, a line drawn through the centers of the upper roll and the lower roll is inclined by 15° in regard to the vertical plane. The number of calender nips may be greater than two, whereby each two calender nip pairs needs two roll change spaces and so upward according to the increasing number of calender nips. The number of rolls in a single assembly of nips may also be larger, whereby a typical arrangement is to use three rolls in a stack. The bearing housings of the calender may be mounted using fixing means different from those described above.

The pull rod arrangement according to the invention is also applicable to single-nip calenders. These types of calenders include, e.g., low-gloss calenders and machine calenders, wherein the peripheral devices of the roll are advantageously integrated into an auxiliary equipment assembly in the manner described above.

What is claimed is:

1. Calender comprising

- at least two calender nips (1, 2) formed by at least two stacked rolls (11 - 14),

- bearing housings (3 - 6) by means of which the rolls (11 - 14) are stacked into roll pairs forming the calender nips (1, 2), and

- means (31, 32) connecting the bearing housings (3, 4 and 4, 5) of the rolls pairs with each other,

c h a r a c t e r i z e d in that

- at least two successive calender nips (1, 2) are arranged so that, in the successive nips, the mutual distance between the longitudinal axes of the lower rolls (12, 14) is smaller than the corresponding mutual distance between the respective upper rolls (11, 13) of the nips, whereby the disposition of the rolls (11 - 14) forms a V-shaped angle as seen from the end of the rolls and thus forms an operating area between the nips for changing the rolls.

2. Calender according to claim 1, c h a r a c t e r - i z e d in that each one of the calender nips (1, 2) has at least one soft roll (11, 14) and at least one heatable hard roll (12, 13).

3. Calender according to claim 1 comprising at least two

frames (21, 22) having said bearing housings (3 - 6) of said rolls (11, 14) mounted thereon, c h a r a c t e r - i z e d by means (24, 36) mounted at least on one of said frames for the purpose of supporting during the change of the lower roll (12, 14) the upper bearing housings (4, 5) at a level higher than their normal operating position.

4. Calender according to claim 1 or 3, c h a r a c - t e r i z e d in that at least the upper rolls (11, 13) have their electrical, fluid and compressed-air and other connections so dimensioned that the rolls can be moved in the vertical direction without any need for dismantling the connections by the distance required for the change of the lower roll.

5. Calender according to claim 4 having adapted to the intervening roll-change space between the rolls at least one roll and possibly also measurement equipment and other devices for handling the web (15) being calendered, c h a r a c t e r i z e d in that the intervening units between the calender nips are combined into an integrated auxiliary equipment assembly (23) which is mounted on the calender frame in a detachable manner and has its connections dimensioned so that the assembly (23) can be lowered below the level of the lower rolls (12, 14) without dismantling the connections of the assembly.

6. Calender according to claim 1, c h a r a c t e r - i z e d in that said means for mounting said bearing housings are pull rods (30), which have locking means (31, 32, 33) so adapted thereon that at the operating

temperature the distance between the proximal edges of said locking means is shorter than the distance between the outer edge surfaces of mounting holes (35) drilled to two superimposed bearing housings (3, 4), and that said pull rods (30) are so heatable that said distance between said proximal edges of said locking means (31, 32, 33) becomes larger than said distance between said outer edge surfaces of said mounting holes.

7. Calender according to claim 6, c h a r a c t e r - i z e d by a bore drilled into the body of the pull rods so as to accommodate therein the insertion of an electrical heater element (34) in a removable or permanent manner.

8. Calender according to claim 1, c h a r a c t e r - i z e d in that said means for connecting said bearing housings to each other comprise at least two clamp pieces (25) having thereto made two clamping surfaces (28) that in an opposed disposition are spaced apart at a distance from each other and, made on the external sides of said bearing housings (3, 4) at a distance from each other, two pairs of compatible clamping surfaces (27), which are oriented outwardly relative to each other and are shaped to form wedge-shaped mating surfaces in combination with said clamping surfaces (28) of said clamp pieces (25), and at least one bolt (26) for compressing said clamp pieces onto said clamping surfaces (27) of said bearing housings.

9. Arrangement for connecting bearing housings (3, 4) to each other in a calender comprising at least two rolls

(13, 14) adapted to form a nip, c h a r a c t e r - i z e d by

- mounting holes (35) drilled to the body of said bearing housings, and

- pull rods (30) having locking means (31, 32, 33) so adapted thereon that at the operating temperature the mutual distance between the proximal edges of said locking means is shorter than the mutual distance between the outer edge surfaces of mounting holes (35) drilled to two superimposed bearing housings (3, 4), and that said pull rods (30) are so heatable that said mutual distance between said proximal edges of said locking means (31, 32, 33) becomes larger than said mutual distance between said outer edge surfaces of said mounting holes.

10. Arrangement according to claim 9 for use in a calender having adapted to the intervening roll-change space between the rolls at least one roll and possibly also measurement equipment and other devices for handling the web (15) being calendered, c h a r a c t e r i z e d in that the intervening units between the calender nips are combined into an integrated auxiliary equipment assembly (23) which is mounted on the calender frame in a detachable manner and has its connections dimensioned so that the assembly (23) can be lowered below the level of the lower rolls (12, 14) without dismantling the connections of the assembly.

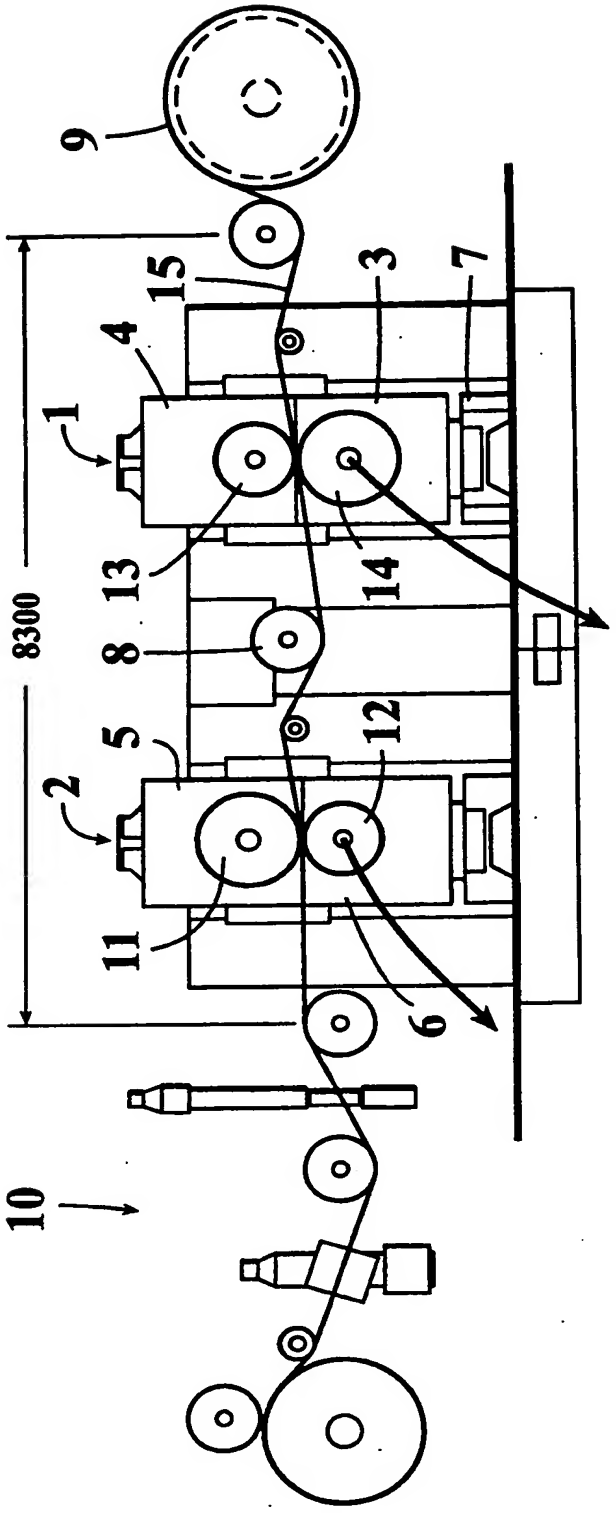

Fig. 1

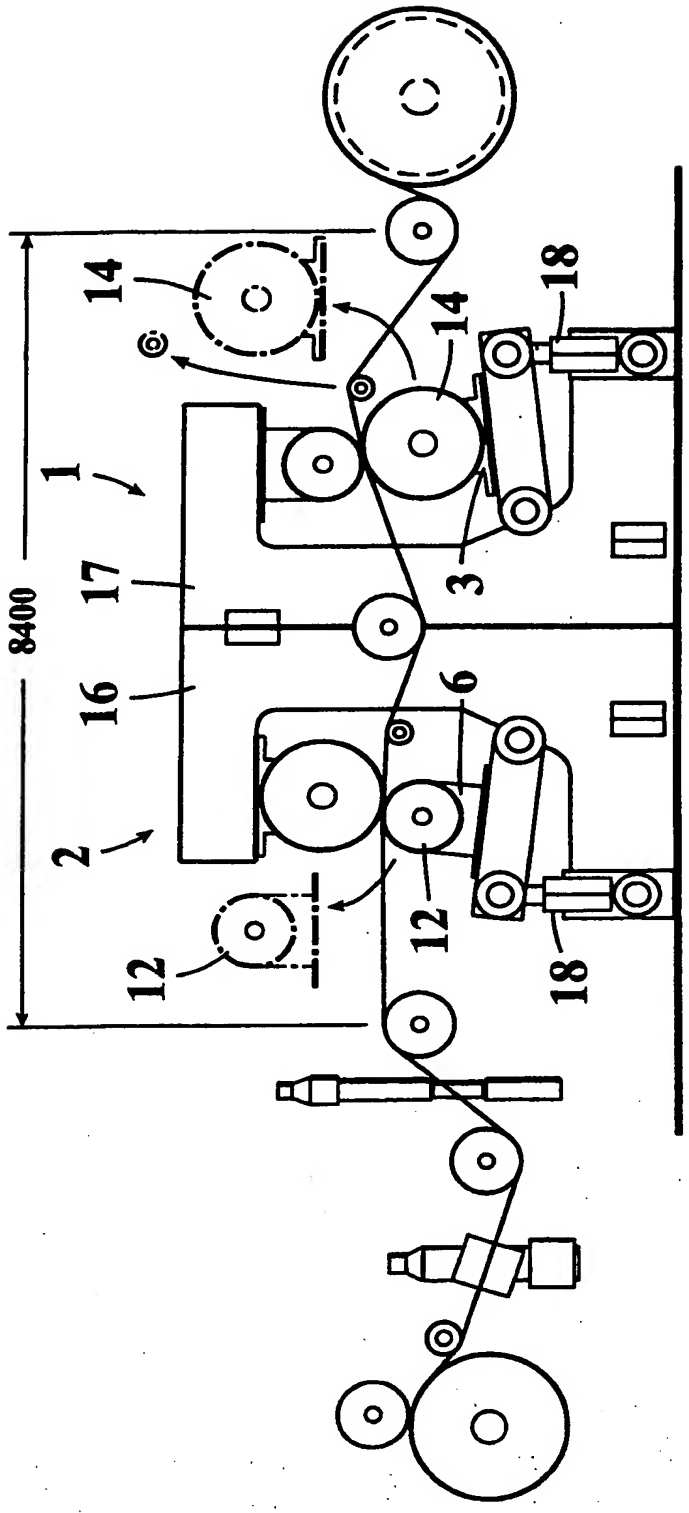

Fig. 2

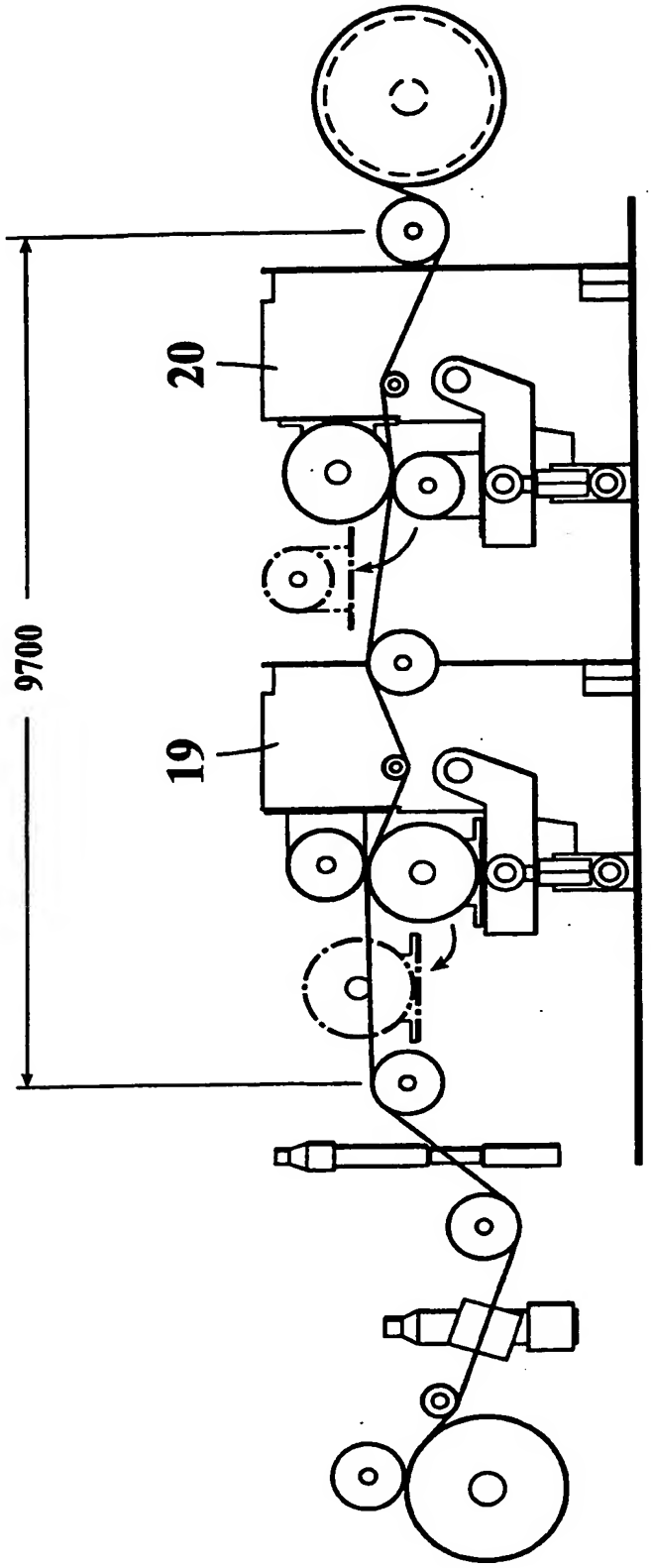

Fig. 3

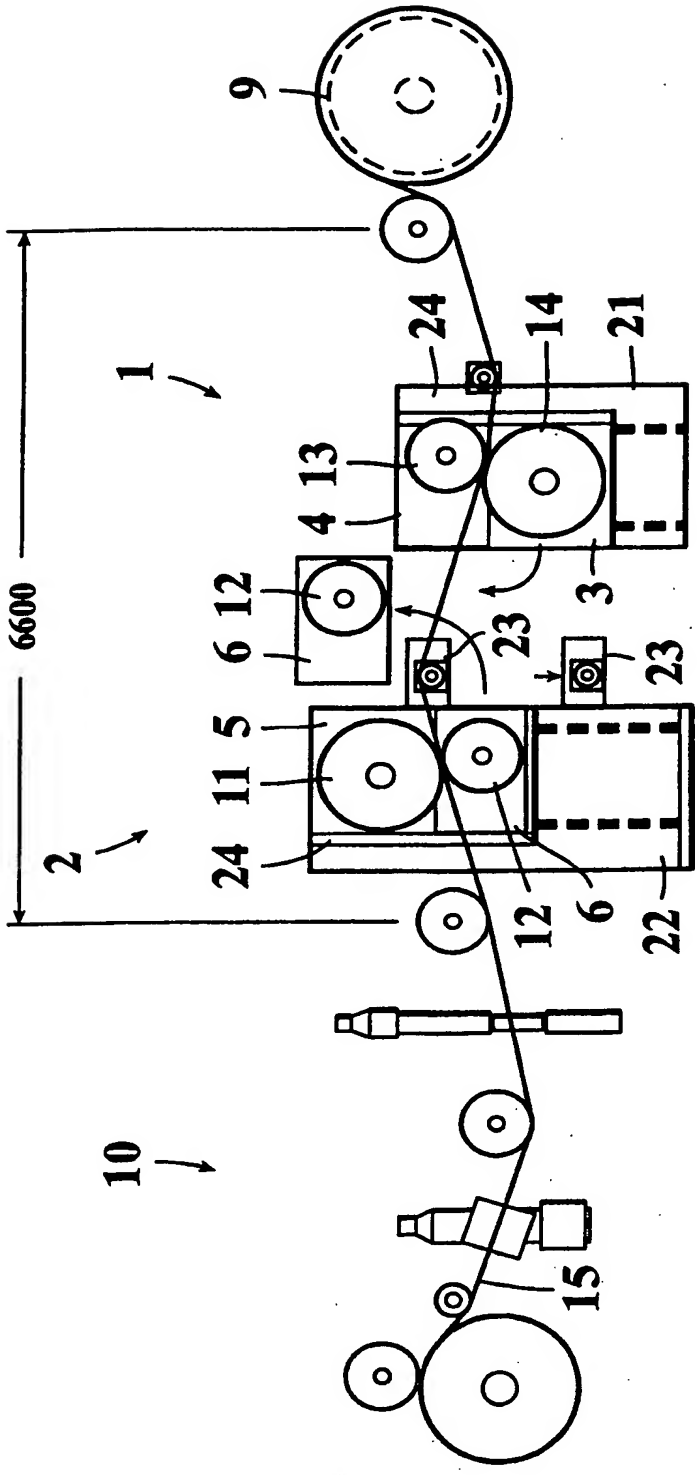

Fig. 4

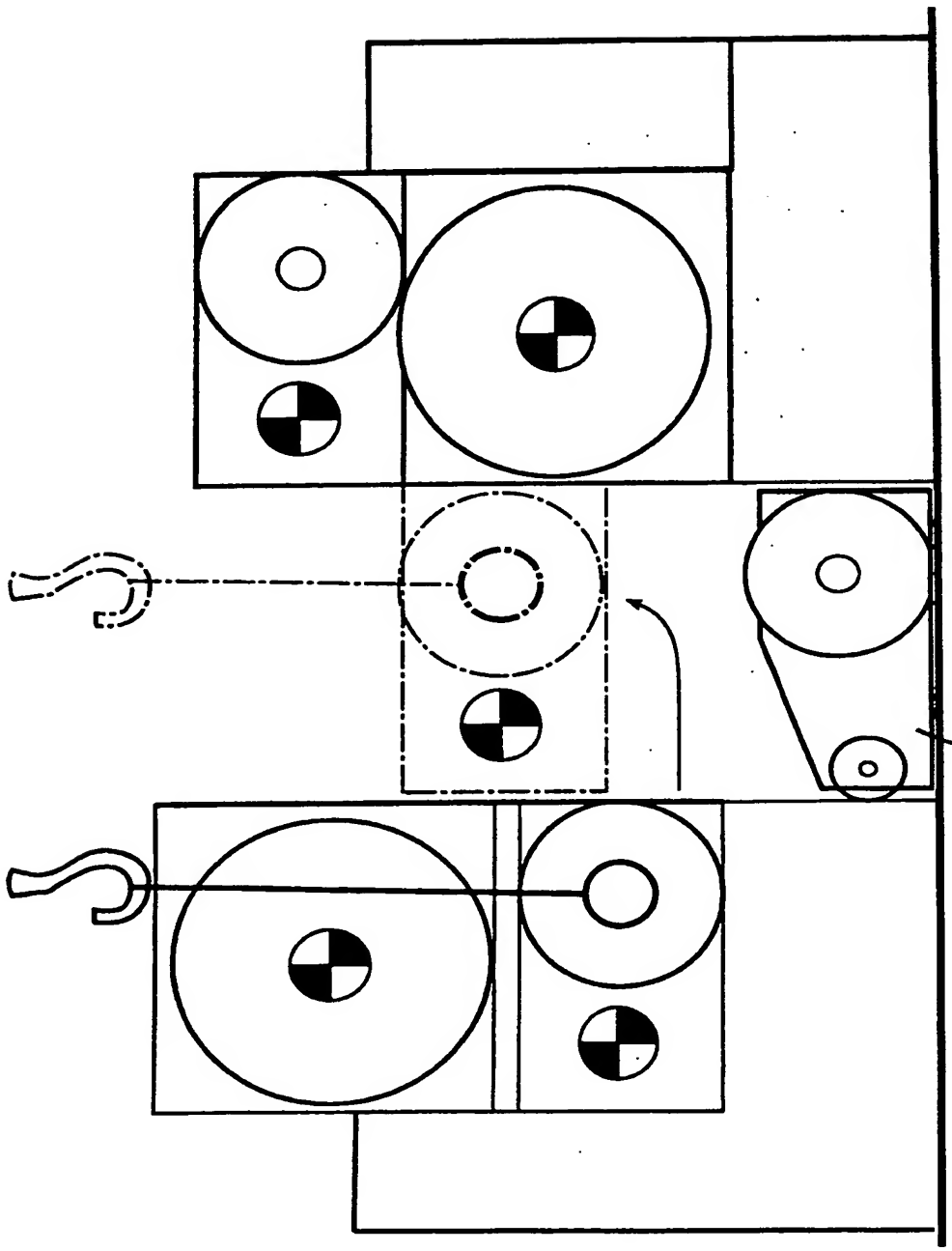

Fig. 5

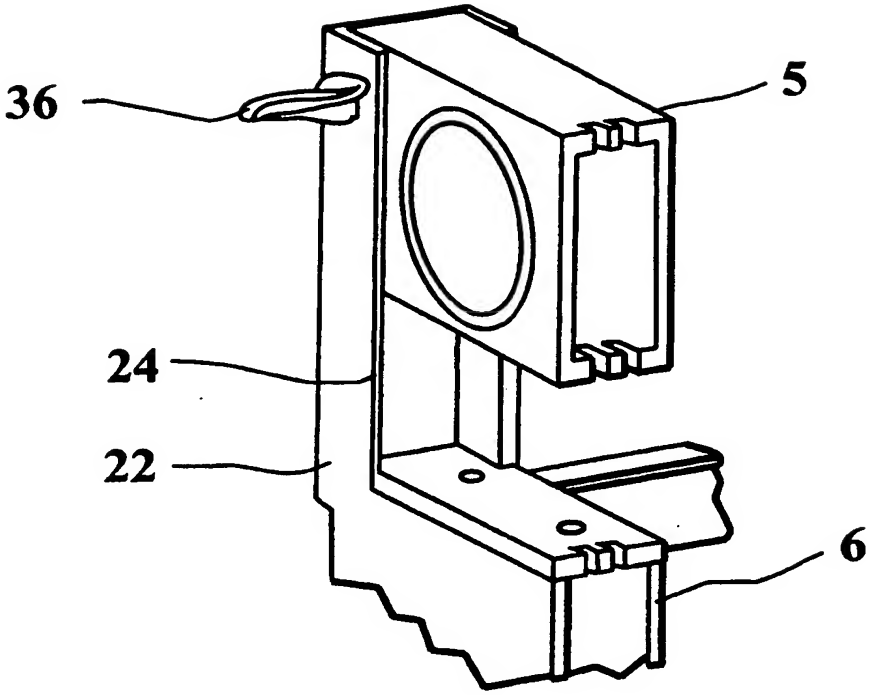

Fig. 6

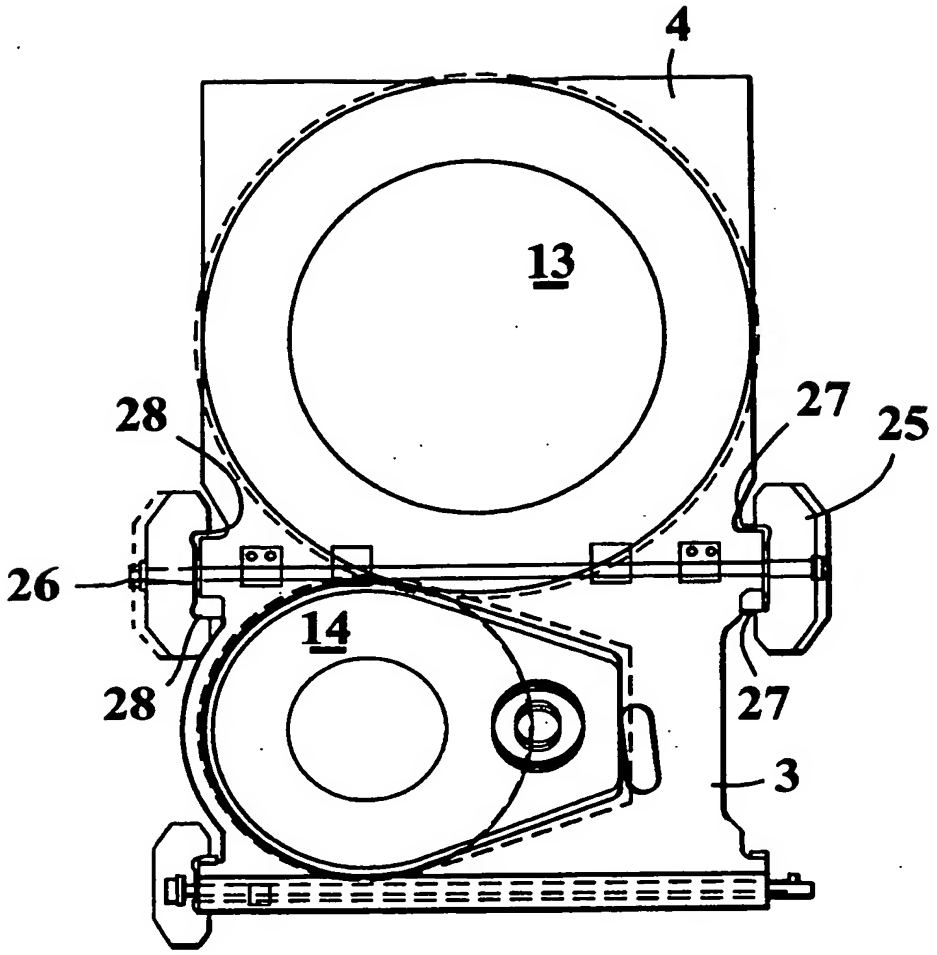

Fig. 7

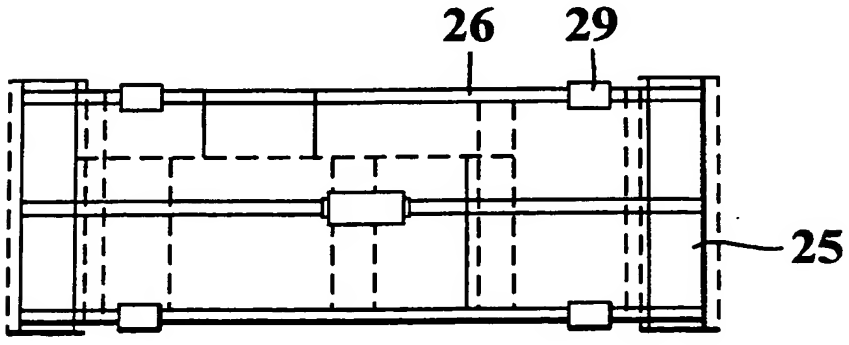

Fig. 8

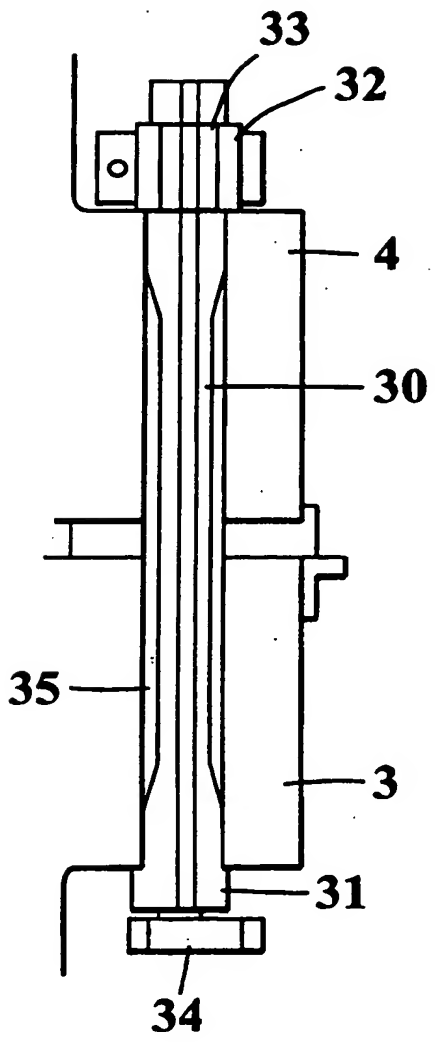

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00885

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21G 1/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4915026 A (MATTI HALME), 10 April 1990 (10.04.90), column 7, line 41 - line 45	1,3,4
Y	--	2,8
Y	DE 4434509 A1 (VALMET PAPER MACHINERY INC.), 13 April 1995 (13.04.95), column 2, line 62 - column 3, line 1	2
	--	
Y	EP 0666367 A1 (VALMET PAPER MACHINERY INC.), 9 August 1995 (09.08.95), column 3, line 43 - line 53	8
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 January 2001	19 -01- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jan Carlerud/ELY Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00885

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4375188 A (VEIKKO LEIVISKÄ), 1 March 1983 (01.03.83), column 5, line 15 - line 19 ---	1-10
A	US 5850785 A (OIVA VALLIUS), 22 December 1998 (22.12.98), figure 4 --- --------	1-10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI00/00885

Box I **Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II **Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

I. Claims 1-8 relate to a calender.
II. Claims 9 and 10 relate to an arrangement for fastening the rolls of the calender.

The special technical feature of Group I is that the nips are deployed in a v-shape layout, leaving a space between them for replacement of the rolls. The special technical feature of Group II is to fasten the bearing housings of the rolls by means of connecting rods provided with locking pins, the distance between said locking pins increasing at a higher temperature. There is no technical relationship among the claimed inventions that involves a corresponding special technical feature and the claims mentioned in Groups I and II are therefore in lack of a single general inventive concept under PCT Rule 13.

However, the search examiner has been able to make a complete international search for the inventions covered by the Groups I and II with negligible additional work.

INTERNATIONAL SEARCH REPORT

Information on patent family members

27/12/00

International application No.
PCT/FI 00/00885

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4915026 A	10/04/90	EP 0424368 A	02/05/91
		FI 80109 B	29/12/89
		FI 871871 A	29/10/88
		WO 8808468 A	03/11/88
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		FI 100353 B	00/00/00
		FI 934499 A	13/04/95
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		GB 9419161 D	00/00/00
		JP 7189167 A	25/07/95
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		AT 173775 T	15/12/98
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		DE 69414819 D,T	12/05/99
		FI 1805 U	22/03/95
		FI 101633 B	00/00/00
		FI 940522 A,V	05/08/95
		JP 7216775 A	15/08/95
		US 5507223 A	16/04/96
US 4375188 A	01/03/83	DE 3121713 A,C	04/03/82
		FI 65106 B,C	30/11/83
		FI 801853 A	11/12/81
		SE 451204 B,C	14/09/87
		SE 8103578 A	11/12/81
US 5850785 A	22/12/98	FI 962336 A	06/12/97

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